

CLAIMS

WHAT IS CLAIMED IS:

1. A drill bit for drilling a well bore using solid material impactors, said drill bit comprising:
 - a center portion comprising a center nozzle;
 - a side arm comprising a side arm nozzle;
 - a center cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said center nozzle; and
 - a side arm cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said side arm nozzle.
2. The drill bit of claim 1 further comprising a junk slot for receiving flow of the solid material impactors after leaving said drill bit.
3. The drill bit of claim 2 further comprising a second junk slot for receiving flow of the solid material impactors after leaving said drill bit.
4. The drill bit of claim 1 further comprising mechanical cutters on the exterior surface of said side arm and said center portion.
5. The drill bit of claim 1 further comprising a mechanical cutter on the side wall of said drill bit.
6. The drill bit of claim 1 further comprising a gauge cutter.
7. The drill bit of claim 1 wherein said central portion comprises a breaker surface.
8. The drill bit of claim 7 wherein said breaker surface is conical in shape.
9. The drill bit of claim 7 wherein said breaker surface comprises a mechanical cutter.

10. The drill bit of claim 1 wherein said center nozzle and said side nozzle are oriented at angles to the longitudinal axis of said drill bit.
11. The drill bit of claim 1 wherein said center nozzle is offset from the longitudinal axis of said drill bit.
12. The drill bit of claim 1 wherein said side arm comprises a mechanical cutter and a groove for guiding the flow of the solid material impactors after leaving said drill bit.
13. The drill bit of claim 1 further comprising more than one side arm and more than one side nozzle.
14. The drill bit of claim 1 further comprising more than one center nozzle.
15. A method of drilling a well bore through a formation comprising:
 - flowing solid material impactors into a drill bit;
 - accelerating said solid material impactors as said solid material impactors flow through said drill bit; and
 - contacting the formation with said accelerated solid material impactors after flowing through said drill bit.
16. The method of claim 15 further comprising accelerating said solid material impactors by flowing said solid material impactors through a cavity within said drill bit and out a nozzle.
17. The method of claim 16 further comprising:
 - flowing solid material impactors through a center cavity in a center portion of said drill bit and out a center nozzle; and
 - flowing solid material impactors through a side arm cavity in a side arm of said drill bit and out a side arm nozzle.

18. The method of claim 15 further comprising flowing solid material impactors through a junk slot on the outer surface of said drill bit after contacting the formation.
19. The method of claim 18 further comprising flowing solid material impactors through a second junk slot on the outer surface of said drill bit after contacting the formation.
20. The method of claim 15 further comprising directing the flow of said solid material impactors from said drill bit at an angle to the longitudinal axis of said drill bit.
21. The method of claim 17 further comprising breaking apart the formation with mechanical cutters on said drill bit.
22. The method of claim 21 further comprising breaking apart the formation with mechanical cutters on said central portion, said side arm, and the side wall of said drill bit.
23. The method of claim 17 further comprising:
 breaking apart the formation with mechanical cutters on said side arm; and
 flowing said solid material impactors through grooves in said side arm after leaving said drill bit.
24. A drill bit for drilling a well bore using solid material impactors, said drill bit comprising:
 a central portion comprising a center nozzle;
 a side arm comprising a side nozzle and a second side nozzle;
 a central cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said center nozzle; and
 a side cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said side nozzle and said second side nozzle.

25. The drill bit of claim 24 further comprising a junk slot for receiving flow of the solid material impactors after leaving said drill bit.
26. The drill bit of claim 25 further comprising a second junk slot for receiving flow of the solid material impactors after leaving said drill bit.
27. The drill bit of claim 24 further comprising mechanical cutters on the exterior surface of said side arm and said center portion.
28. The drill bit of claim 24 further comprising a mechanical cutter on the side wall of said drill bit.
29. The drill bit of claim 24 further comprising a gauge cutter.
30. The drill bit of claim 24 wherein said central portion comprises a breaker surface.
31. The drill bit of claim 30 wherein said breaker surface is conical in shape.
32. The drill bit of claim 30 wherein said breaker surface comprises a mechanical cutter.
33. The drill bit of claim 24 wherein said center nozzle, said side nozzle, and said second side nozzle are oriented at angles to the longitudinal axis of said drill bit.
34. The drill bit of claim 24 wherein said center nozzle is offset from the longitudinal axis of said drill bit.
35. The drill bit of claim 24 wherein said side arm comprises a mechanical cutter and a groove for guiding the flow of the solid material impactors after leaving said drill bit.

36. The drill bit of claim 24 further comprising more than one side arm and more than one side nozzle and second side nozzle.
37. The drill bit of claim 24 further comprising more than one center nozzle.
38. A method of drilling a well bore through a formation comprising:
 flowing solid material impactors into a drill bit;
 accelerating said solid material impactors as said solid material impactors flow through said drill bit by flowing said solid material impactors through a center cavity within a center portion of said drill bit and out a center nozzle and through a side arm cavity in a side arm of said drill bit and out a side nozzle and a second side nozzle;
 contacting the formation with said accelerated solid material impactors after flowing through said drill bit.
39. The method of claim 38 further comprising flowing solid material impactors through a junk slot on the outer surface of said drill bit after contacting the formation.
40. The method of claim 39 further comprising flowing solid material impactors through a second junk slot on the outer surface of said drill bit after contacting the formation.
41. The method of claim 38 further comprising directing the flow of said solid material impactors from said drill bit at an angle to the longitudinal axis of said drill bit.
42. The method of claim 38 further comprising breaking apart the formation with mechanical cutters on said drill bit.
43. The method of claim 38 further comprising breaking apart the formation with mechanical cutters on said central portion, said side arm, and the side wall of said drill bit.
44. The method of claim 38 further comprising:

breaking apart the formation with mechanical cutters on said side arm; and
flowing said solid material impactors through grooves in said side arm after
leaving said drill bit.

45. A drill bit for drilling a well bore using solid material impactors, said drill bit comprising:
 - a central portion comprising a center nozzle;
 - a side arm comprising a side nozzle;
 - a second side arm comprising a second side nozzle;
 - a central cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said center nozzle;
 - a side cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said side nozzle; and
 - a second side cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said second side nozzle.
46. The drill bit of claim 45 further comprising a junk slot for receiving flow of the solid material impactors after leaving said drill bit.
47. The drill bit of claim 46 further comprising a second junk slot for receiving flow of the solid material impactors after leaving said drill bit.
48. The drill bit of claim 45 further comprising mechanical cutters on the exterior surface of said side arm and said center portion.
49. The drill bit of claim 45 further comprising a mechanical cutter on the side wall of said drill bit.
50. The drill bit of claim 45 further comprising a gauge cutter.
51. The drill bit of claim 45 wherein said central portion comprises a breaker surface.

52. The drill bit of claim 51 wherein said breaker surface is conical in shape.
53. The drill bit of claim 51 wherein said breaker surface comprises a mechanical cutter.
54. The drill bit of claim 45 wherein said center nozzle, said side nozzle, and said second side nozzle are oriented at angles to the longitudinal axis of said drill bit.
55. The drill bit of claim 45 wherein said center nozzle is offset from the longitudinal axis of said drill bit.
56. The drill bit of claim 45 wherein said side arm comprises a mechanical cutter and a groove for guiding the flow of the solid material impactors after leaving said drill bit.
57. The drill bit of claim 45 further comprising more than one side arm and more than one side nozzle.
58. The drill bit of claim 45 further comprising more than one center nozzle.
59. A method of drilling a well bore through a formation comprising:
 flowing solid material impactors into a drill bit;
 accelerating said solid material impactors as said solid material impactors flow through said drill bit by flowing said solid material impactors through a center cavity within a center portion of said drill bit and out a center nozzle, through a side arm cavity in a side arm of said drill bit and out a side nozzle, and through a second side arm cavity in a second side arm and out a second side nozzle;
 contacting the formation with said accelerated solid material impactors after flowing through said drill bit.

60. The method of claim 59 further comprising flowing solid material impactors through a junk slot on the outer surface of said drill bit after contacting the formation.
61. The method of claim 60 further comprising flowing solid material impactors through a second junk slot on the outer surface of said drill bit after contacting the formation.
62. The method of claim 59 further comprising directing the flow of said solid material impactors from said drill bit at an angle to the longitudinal axis of said drill bit.
63. The method of claim 59 further comprising breaking apart the formation with mechanical cutters on said drill bit.
64. The method of claim 59 further comprising breaking apart the formation with mechanical cutters on said central portion, said side arm, said second side arm, and the side wall of said drill bit.
65. The method of claim 59 further comprising:
 breaking apart the formation with mechanical cutters on said side arm and said second side arm; and
 flowing said solid material impactors through grooves in said side arm and said second side arm after leaving said drill bit.
66. A drill bit for drilling a well bore using solid material impactors, said drill bit comprising:
 a nozzle;
 a cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said nozzle; and
 a junk slot for receiving flow of the solid material impactors after leaving said drill bit.

67. The drill bit of claim 66 further comprising mechanical cutters on the exterior surface of said drill bit.
68. The drill bit of claim 66 further comprising a gauge cutter.
69. The drill bit of claim 66 wherein said nozzle is oriented at an angle to the longitudinal axis of said drill bit.
70. The drill bit of claim 66 wherein said nozzle is offset from the longitudinal axis of said drill bit.
71. The drill bit of claim 66 further comprising:
a second nozzle and a second cavity for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said second nozzle; and
a second junk slot for receiving flow of the solid material impactors after leaving said drill bit.
72. The drill bit of claim 71 wherein at least one of said nozzle and said second nozzle is oriented at an angle to the longitudinal axis of said drill bit.
73. The drill bit of claim 71 wherein at least one of said nozzle and said second nozzle is offset from the longitudinal axis of said drill bit.
74. The drill bit of claim 66 further comprising:
more than two nozzles and more than two second cavities for accelerating the velocity of the solid material impactors and directing flow of the solid material impactors through said nozzles; and
more than two junk slots for receiving flow of the solid material impactors after leaving said drill bit.

75. The drill bit of claim 74 wherein at least one nozzle is oriented at an angle to the longitudinal axis of said drill bit.

76. The drill bit of claim 74 wherein at least one nozzle is offset from the longitudinal axis of said drill bit.